Smart Storage of Landfilled Waste

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RESEARCH OBJECTIVES

Although Subtitle D landfills are permitted to contain only nonhazardous municipal solid waste (MSW), in fact they often include substances such as metals, solvents, halogenated organics and mercury. Currently, most landfills are "dry tombs" because moisture and air exposure are restricted, slowing biodegradation of the waste and increasing the time required for landfill stabilization. The time period over which the waste presents itself as a risk for contamination of air and water extends to decades, severely limiting land reuse options. In addition, landfill costs have more than doubled in the last 15 years, as the requirements for stabilization and containment of waste have become increasingly stringent, and obtaining a permit for a new landfill site has become more costly.

Smart Storage is the active control of the waste containment environment for accelerated degradation and stabilization of landfill waste. Smart Storage provides a framework for managing landfilled waste that includes long-term, cost-effective, and environmentally sustainable solutions based on bioreactor technology. Extreme heterogeneity and the large scale of landfills make comparison between the technologies difficult. This study directly compares identical MSW samples in controlled laboratory conditions to give relative rates of settlement, gas production, and leachate quality to support the decision-making process concerning aerobic and anaerobic strategies.

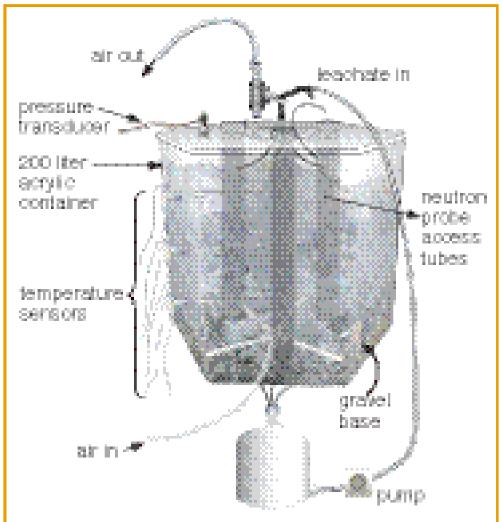

Figure 1. Schematic of the laboratory landfill bioreactor

APPROACH

Mesoscale laboratory reactor systems (see Figure 1) filled with MSW were used to measure respiration rates, methane and carbon dioxide generation rates, subsidence, and leachate quality. Three treatments were applied to the bioreactors: (1) aerobic landfill (air injection with water addition and leachate recirculation), (2) anaerobic landfill (no air injection, water addition and leachate recirculation) and (3) no treatment (no air injection or leachate recirculation), which was converted to a wet, aerobic landfill (air injection with water addition and leachate recirculation).

ACCOMPLISHMENTS

Measurements of leachate quality and gas production clearly demonstrate that aerobic treatment of MSW creates a more stable and environmentally benign waste mass over a shorter treatment time than does anaerobic waste treatment. Comparison of carbon production from both aerobic and anaerobic reactors shows that in the 400-day test period, the aerobic tank produced 6 mol C/kg MSW, whereas the anaerobic bioreactor produced 4 mol C/kg waste. Thus, the aerobic tank was 50% more stabilized than the anaerobic bioreactor. Additionally, methane production was slowed in the anaerobic tank by excess ammonia production, potentially requiring an additional treatment step for removal. Elevated levels of several metals and biochemical oxygen demand were measured in the anaerobic leachate. These leachate quality issues associated with the anaerobic system would require additional investigation.

SIGNIFICANCE OF FINDINGS

This study directly compared identical MSW samples in controlled laboratory conditions to give relative rates of settlement, gas production, and leachate quality to support the decision-making process concerning aerobic and anaerobic strategies. The study shows that although both aerobic and anaerobic treatment is superior to dry-tomb landfill management, the aerobic treatment is a more sustainable and environmentally friendly solution.

RELATED PUBLICATION

Borglin, S.E., T.C. Hazen, C.M. Oldenburg, and P.T. Zawislanski, Comparison of aerobic and anaerobic biotreatment of municipal solid waste. Journal of the Air and Waste Management Association, June 2003 (submited).

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